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and depression, and probably of volcanic activity. He thinks also that the tendency of the evidence is to show that some granitoid rocks, such as those classed in Wales under the name Dimetian, are among the very oldest of the pre-Cambrian rocks which are now found exposed, and that some quartzites, porcellanites, and schists occupy an intermediate position in point of age between these granitoid rocks and the Pebidian series. (*Geol. Mag.*, Nov., 1890.)

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—Mount Aviólo, in the southern Alps, consists in part of tonalite and in part of a quartz-mica-diorite, both of which intersect a series of crystalline schists, in which contact alteration has been effected. The tonalite is the rock so well known as comprising a large part of the Adamello group of the Alps. It is essentially a hornblendic quartz-mica-diorite. A garnetiferous variety is described by Salomon[2] as an endomorphous contact product. It is characterized by the possession of plagioclase zonally developed, with the most acid zones on the exterior. The extinction of crystals varies as much as 30°, being by this much greater in the nucleus than in the peripheral portions. The quartz-mica-diorite forms a boss only two kilometers distant from that of the tonalite, but it is regarded by the author as having no genetical relation with the latter. These two masses of eruptives are surrounded by two series of schists: a younger series including phyllites and epidote-amphibolites, and an older one embracing gneiss and mica-schists. The former are in contact with the diorite, by which they have been changed into rocks composed essentially of quartz, muscovite, biotite, chlorite, and andalusite, of which the biotite and andalusite are new products. Corundum, tourmaline, sillimanite, and zircon are also new products, but are present only in small quantity. A cordierite-biotite rock, consisting of these minerals together with quartz, was found as an inclusion in the diorite. According to the degree of alteration effected in them the rocks are separated into two zones: an outer one, the zone of the ilmenite-frucht-schiefer, in which the phyllites have suffered merely the change of their chlorite into biotite, and an inner zone, in which andalusite is an important constituent. The schists around the tonalite belong to the older series of gneiss and mica-schists. These have been more completely metamorphosed than the members of the phyllite series, for in addition to andalusite there is an abundant development of cordierite in them, where they approach the eruptive. As in the case of the diorite contact belt, there have also been recognized in the belt surrounding the tonalite two distinct contact zones. In the outer one the normal gneiss and mica-schists have been changed into cordierite and andalusite varieties, containing a fibrous orthoclase. In the inner zone all resemblance to gneiss and mica-schists has disappeared, and the rocks have become aggregates of cordierite, andalusite, plagioclase, sillimanite, tourmaline, garnet, spinel, corundum, and zircon. The replacement of the orthoclase of the outer zone by plagioclase in the inner one indicates a difference in the composition of the two belts, but this is thought not to be a result of more intense metamorphism, but as due rather to a difference in the composition of the original materials. The cordierite in these rocks is colorless and non-pleochroic, but it becomes brown and pleochroic on heating. It often twins parallel to ∞P, and alters readily to a pinnite-like substance. The other constituents possess no unusual peculiarities. They are all well described, but none are analyzed. Dykes of porphyrite cut the schists, and a single one occurs in the tonalite, but none of them merit special mention in this place.——The most valuable contribution to the study of the crystalline schists that has appeared for some time is entitled "The Greenstone-Schist Areas of the Menominee and Marquette Regions of Michigan." In it the author, Dr. G. H. Williams,[3] discusses the origin of the crystalline schists found so widely spread over the country bordering on Lake Superior. The paper opens with an excellent historical review of the recent work on crystalline schists in Europe, in which all the important articles on dynamically formed schists are abstracted. This chapter, together with the foot-notes accompanying it, form a splendid résumé of the present state of our knowledge on this subject, and is well worthy the study of all geologists, particularly of those who still hold to the belief that all schistose rocks were originally laid down as sediments. In the special part of the volume the author describes the present features of the green schists of Michigan, and shows conclusively that these were once igneous rocks, often volcanic flows, sometimes tufas, in which foliation and mineral changes have been produced by dynamic agencies. The rocks from which the schists were formed were diabases, diabase-porphyries, diorites, and gabbros among the basic types, and granites and quartz-porphyries among the acid types. The resulting types are chlorite and hornblende-schists, granulites, gneisses and porphyroids, sericite-schists, and other foliated rocks. An important part of the study is that embracing the discussion of the effects of pressure upon the mineral constituents of the original rocks, and of the new structures produced in the secondary rocks. The new minerals formed during the production of the schists are albite, microcline, zoisite, garnet, quartz, hornblende, epidote, biotite, muscovite, sericite, rutile, anatase, and sphene. Each of these is carefully described, and the conditions under which it was formed are carefully examined. The genesis of the schistose structure is finely worked out, both macroscopically and microscopically, and the mineral change that accompanies the development of the foliation is well shown. A large body of green schists is thus proven to have been developed by pressure from massive rocks, just as the gabbro-diorites were formed from gabbros in the Baltimore region. There are many interesting features of the Michigan schists that might be dwelt upon at some length did space permit, and many important mineralogical metamorphoses might be referred to. But no review, however full, can do more than suggest the outline of the bulletin. It must be read to be understood. The many good maps and illustrations and the nine lithographic plates of rock structures render great aid to the reader. It is evident that the schists of Michigan cannot grade into the overlying fragmentals, and since they are much more squeezed than these, that they cannot be of the same age.——An important communication, bearing upon the relation existing between dyke rocks and their corresponding plutonic facies, has lately appeared under the names of Hunter and Rosenbusch,[4] who have discovered that one of the rocks occurring in dyke form in the elæolite-syenite region of the Serra de Tinguá, Brazil, is a new type, which may be regarded as the equivalent of the plutonic elæolite-syenite. The rock has been called trachyte, phonolite, and basalt by various writers, but the present authors have decided to give it a distinctive name, "monchiquite," from the locality in Portugal from whence the type was first described. The rock belongs among the camptonites. It is of a dark color, and is composed of a dense ground-mass holding small phenocrysts of amphibole, pyroxene, mica, and olivine. Carefully examined, the ground-mass is found to be a colorless glass containing microlites of the same minerals as occur in the phenocrysts, and occasionally a few laths of plagioclase. The glassy base has a composition that indicates a close relationship with elæolite-syenite :

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Zeits. d. deutsch. geol. Ges.*, XLII., 1890, p. 450.

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[3] Bull. No. 62, U. S. Geol. Survey.

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[4] *Miner. u. Petrog. Mitth.*, XI., 1890, p. 445.

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	CO_2
Rock	46.48	.99	16.16	6.17	6.09	4.02	7.35	5.85	3.08	4.27	.45
Base	53.43		20.86	2.61		.29	1.14	11.63	2.51	7.06	

But little interest attaches to the components of the rock. The hornblende and augite are often zonally developed. In the former the kernel shows evidence of having been corroded, while the external envelope never exhibits sign of such resorption. Analyses of one variety of the augite and of the hornblende appear in the paper. The latter mineral contains 3.37 per cent. of K_2O.——As the result of a microscopic study of the "Weissenberg gneiss," in Saxony, in which cordierite and other characteristic contact minerals were discovered, Weber[5] pronounces the rock a member of the graywacke series that has been metamorphosed by the Lausitz granite.—The basalt of Royat (Puy-de-Dome) contains geode-like cavities lined with calcite and other minerals. Calcite also fills crevices and holds fragments of the rock torn from the sides of the clefts. In some of these fragments are crystals of feldspar with the morphological and optical properties of orthoclase, but with a large proportion of sodium in its composition ($SiO_2 = 66.83$; $Al_2O_3 = 19.20$; $CaO = .06$; $K_2O = 6.29$; $Na_2O = 6.8$).[6]——Zirkel[7] has determined the small hexagonal crystals in the altered sandstone of Steinberg, in the Habichtswald, Germany, to be cordierite, produced probably by the solution of the interstitial substance of the sandstone by basalt.——Termier[8] notes the occurrence of veins of orthoclase and quartz in the silicified Carboniferous schists of Saint-Étiénne, whose structure is neither micropegmatitic nor microgranulitic, though both minerals were deposited simultaneously from the same mother-liquor. He also describes briefly a silicified schist consisting of bands of opal and chalcedony, from the Butte of Montraynand.——Quartz-twins occur porphyritically developed in the pumice of Cobo de Gata.[9]

Miscellaneous.—Offret[10] has recently published a very exhaustive account of some investigations upon the effect of various temperatures upon the indices of refraction of several minerals, for every color in the visible spectrum. His paper opens with an historical review of the work already published. Then follows a very full description of the methods used in his investigations, and of the apparatus employed. A thorough discussion of the limitations of his methods covers about a hundred pages. After showing that the results obtained by the method used, which is that of the prism, are quite accurate, he records his measurements upon calcite, beryl, phenacite, aragonite, barite, cordierite, two topaz crystals from different localities, orthoclase, and oligoclase, at temperatures up to 330°. In two tables, appended to the statements of general results reached in each case, are given the indices of refraction for six differently colored rays moving along the several axes of elasticity in each mineral, and under different conditions of temperature: (1) as measured in warm air, (2) as calculated for a vacuum. A third table contains the values of the double refraction calculated for a vacuum, and a fourth represents the variations in the angle of the prism used produced by different temperatures. Without entering into the details of the investigation, it may be said that the figures reached by the author are worthy of the greatest confidence, and that when differing from those obtained by other observers they must be accepted in place of these latter. Among the most interesting of the general results obtained are the following: Of the minerals examined only barite and aragonite show a refractive index decreasing with an increase in temperature. There is a general increase in the value of the optical angle and in the dispersion of the axes, with increase in temperature. The double refraction increases with the temperature only in the case of beryl. Brazilian topaz is the only mineral showing a decrease in the amount of double refraction, in passing from red to violet light. Other points of interest brought out in the work are too numerous for mention here. The paper covers two hundred and eighty-seven pages.——In a recent communication Behrens[11] gives a very valuable synopsis of microchemical methods, applicable not only to the determination of the constituents of minerals in thin sections of rocks, but useful also as aids to the blowpipe in determinative mineralogy. His article opens with a few introductory remarks on manipulation. Then follows a résumé of the tests that have given most satisfaction in the detection of fifty-nine of the elements. These are arranged alphabetically, and under each are given the directions for making the tests selected.——Wyrouboff[12] proposes a new theory for the explanation of polymorphism, and shows how this may include also the explanation of pseudo-symmetry. His paper, which is a very clear exposition of his views, opens with the account of his understanding of the differences between polymerism, polymorphism, and pseudo-symmetry. The first he regards as purely chemical, and as not affecting in any way the arrangement of particles in crystals. It has to do merely with the molecules, while polymorphism has to do with the crystal particles.[13] The molecules unite according to certain definite laws, yielding the crystal particles, which may exist even in solution, when they may reveal themselves by their effect upon polarized light. The crystal particles are in their turn disposed regularly to form the crystal. When this disposition is identical with that of the molecules in the crystal particles a symmetrical body results. When the arrangement of the particles is different from that of their constituent molecules the body is pseudo-symmetrical. The various forms of a polymorphic body belong to the first class, which is divided into two groups. In the first belong those substances in which a change in crystallization occurs without a corresponding change in homogeneity. In the second class belong those bodies which, when heated, break up into a large number of individuals of a different grade of symmetry from the original individual, without definite contours and without definite arrangement. To explain the first class the author supposes the molecules in the crystal particles to undergo a rearrangement coincident with that of the particles themselves. This is called direct polymorphism. Indirect polymorphism is the term applied to the change the second class of substances undergo. In these the symmetry of the particles changes, while that of the aggregate of particles remains unchanged. To the first class only is the term polymorphism strictly applicable. The second class belong rather to the paramorphic bodies. The second part of the paper contains results of observations on polymorphic substances, among which are the bichromates of rubidium, potassium, and ammonium, and the sulphates of sodium and of lithium.——O. Lehmann,[14] in a very brief communication, states his view of crystal structure, which is quite different from that of Wyrouboff. He declares that the essential condition of a crystal is not the regular arrangement of the molecules in the particles, but it is the construction of these molecules. He also reiterates the statement made in his "Molecular Physik" to the effect that no chemical substance can crystallize in more than one way. Allotriomorphic and polymorphic substances are different chemically. In a second paper[15] he gives brief descriptions of eight additional organic compounds that show allotropic forms.——The parts of Dr. Hintze's[16] Mineralogy continue to appear with commendable rapidity. The fourth part concludes the discussion of prehnite, takes up in order axinite, harstigite, and the pyrosmalite group, and begins the treatment of the micas, which occupies one hundred-and-twenty-five pages, and is not yet finished. Although there are perhaps some omissions to be noted with respect to American occurrences, the thoroughness of the author's work cannot be gainsaid. The analyses of biotite given in the article on that mineral number 177, and those of muscovite 120, in addition to some twenty or thirty of varieties of these minerals.——Dufêt[17] describes a new method for the determination of the optical orientation and of the dispersion of the axes in triclinic minerals, and applies his method to the study of potassium bichromate.——Mr. Lane[18] illustrates a method for determining the planes in crystals in thin section. It is based in the relations existing between the zone-circles and face-points in a stereographic projection.

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[5] *Neues Jahrb. f. Min.*, etc., 1891, I., p. 211.

[6] Jannetaz. Bull. Soc. Franc. d. Min., XIII., 1890, p. 372.

[7] *Neues Jahrb. f. Min.*, etc., 1891, I., p. 109.

[8] Bull. Soc. Franc. d. Min., XIII., 1890, p. 330.

[9] Osann. *Neues Jahrb. f. Min*, etc., 1891, I., p. 108.

[10] Bull. Soc. Franc. d. Min., XIII., 1890, p. 450.

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[11] *Neues Jahrb. f. Min.*, etc., B. B. VII., p. 434.

[12] Bull. Soc. Franc. d. Min., XIII., 1890, p. 277.

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[13] Cf. AMERICAN NATURALIST, Feb., 1890, p. 174.

[14] *Zeits. f. Kryst.*, XVIII., 1890, p. 456.

[15] Ib., p. 464.

ZOOLOGY.

The Coloration of the Flounders.—Whoever has seen the flounders alive, or even dead but not deprived of their skin, has noticed the remarkable difference existing between the dorsal aspect exposed to the water and the ventral surface which in the living animal moves along the bottom. While the dorsal face is more or less pigmented, the ventral is white. Why is this? The school of Weismann, more Darwinian than Darwin himself, is accustomed to attribute the fact to natural selection; and the school, which is rapidly increasing, according to which the environment affects the animal, ought to attribute it to a physical influence, in view of the fact that the ventral side receives naturally much less light than the dorsal. In truth, one cannot see how natural selection could produce it. From this point of view the coloration of the ventral side seems of no importance, and if it is not one would think that it is more advantageous to the flounder to have this side gray, like the dorsal, rather than white,—that is to say, showy. Professor Cunningham, of the Marine Biological Association, has recently studied this phenomenon, and believes that it is caused by the

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[16] Handbuch der Mineralogie. 4te Lief., pp. 481–640. Leipzig, 1891.

[17] Bull. Soc. Franc. d. Min., 1890, p. 341.

[18] Bull. Geol. Soc. Amer., Vol. II., 1891, p. 365.